

AMENDMENTS TO THE CLAIMS

This listing of claims will replace all prior versions and listings of claims in the application:

LISTING OF CLAIMS:

1. (Currently amended): A memory system comprising:

a plurality of memory modules provided with memory areas for holding data and buffer sections for sending and receiving the data;

a hard disk device to which the data stored in said memory modules is copied at predetermined time periods;

a control device which, when an arbitrary memory module is being replaced, switches an operational mode of a ring bus from a unidirectional bus ~~capable of sending and receiving which either sends or receives~~ a signal unidirectionally, to a bi-directional bus ~~capable of sending and receiving which sends and receives~~ a signal bi-directionally, detects an address space of said memory module to be replaced, and accesses a memory area in said hard disk device corresponding to the detected address space at the time when an access to said memory module being replaced is requested; and

a CPU which controls said control device for access operation to said memory modules, wherein said buffer sections are connected in series to form the ring bus with said control device, each having a buffer circuit for causing said ring bus to operate as said unidirectional bus or said bi-directional bus in accordance with an instruction from said control device, and

wherein said control device comprises:

a first buffer circuit for receiving a signal from one input/output end of the ring bus;

a second buffer circuit for sending a signal to one input/output end of the ring bus;
a third buffer circuit for receiving a signal from the other input/output end of the ring bus;
and
a fourth buffer circuit for sending a signal to the other input/output end of the ring bus.

2. (Currently amended): A memory system comprising:
a plurality of memory modules provided with memory areas for holding data and buffer sections for sending and receiving the data;
a hard disk device to which the data stored in said memory modules is copied at predetermined time periods;
a storage to which data stored in an arbitrary memory module is temporarily copied;
a control device which, when an arbitrary memory module is being replaced, switches an operational mode of a ring bus from a unidirectional bus ~~capable of either sending or receiving~~ which either sends or receives a signal unidirectionally, to a bi-directional bus ~~capable of sending and receiving~~ which sends and receives a signal bi-directionally, detects an address space of said memory module to be replaced, copies data corresponding to the detected address space from said hard disk device to said storage, and accesses a memory area in said storage corresponding to the detected address space at the time when an access to said memory module being replaced is requested; and
a CPU which controls said control device for access operation to said memory modules,

wherein said buffer sections are connected in series to form the ring bus with said control device, each having a buffer circuit for causing said ring bus to operate as said unidirectional bus or said bi-directional bus in accordance with an instruction from said control device, and

wherein said control device comprises:

a first buffer circuit for receiving a signal from one input/output end of the ring bus;

a second buffer circuit for sending a signal to one input/output end of the ring bus;

a third buffer circuit for receiving a signal from the other input/output end of the ring bus;

and

a fourth buffer circuit for sending a signal to the other input/output end of the ring bus.

3. (Original): The memory system according to claim 1, further comprising a short-circuit device for, when an arbitrary memory module is replaced, recovering bus connection which is disconnected by removing said memory module.

4. (Original): The memory system according to claim 2, further comprising a short-circuit device for, when an arbitrary memory module is replaced, recovering bus connection which is disconnected by removing said memory module.

5. (Currently amended): A memory system comprising:

a plurality of memory modules provided with memory areas for holding data and buffer sections for sending and receiving the data;

a hard disk device to which the data stored in said memory modules is copied at predetermined time periods;

a storage to which data stored in an arbitrary memory module is temporarily copied;

a short-circuit device which, when an arbitrary memory module is being replaced, recovers a bus connection which is disconnected by removing said memory module being replaced;

a control device which, when an arbitrary memory module is being replaced, detects an address space of said memory module being replaced, copies data corresponding to the detected address space from said hard disk device to said storage, and accesses a memory area in said storage corresponding to the detected address space at the time when an access to said memory module being replaced is requested; and

a CPU which controls said control device for access operation to said memory modules, wherein said buffer sections are connected in series to form a unidirectional bus ~~capable of either sending or receiving~~ which either sends or receives a signal unidirectionally, and

wherein said control device comprises:

a first buffer circuit for receiving a signal from one input/output end of the ring bus;

a second buffer circuit for sending a signal to one input/output end of the ring bus;

a third buffer circuit for receiving a signal from the other input/output end of the ring bus;

and

a fourth buffer circuit for sending a signal to the other input/output end of the ring bus.

6. (Original): The memory system according to claim 3, wherein said short-circuit device is a dummy module which is inserted instead of said memory module to be replaced and is provided with a short-circuit line for short-circuiting bus connection which is disconnected by removing said memory module.

7. (Original): The memory system according to claim 4, wherein said short-circuit device is a dummy module which is inserted instead of said memory module to be replaced and is provided with a short-circuit line for short-circuiting bus connection which is disconnected by removing said memory module.

8. (Original): The memory system according to claim 5, wherein said short-circuit device is a dummy module which is inserted instead of said memory module to be replaced and is provided with a short-circuit line for short-circuiting bus connection which is disconnected by removing said memory module.

9. (Original): The memory system according to claim 3, wherein said short-circuit device is an FET switch, which is provided in association with said memory modules, respectively, for short-circuiting or opening bus connection which is disconnected by removing said memory module, and

in replacing an arbitrary memory module, said control device generates a control signal for turning ON the FET switch provided in association with said memory module to be replaced and turning OFF the FET switches provided in association with the other memory modules.

10. (Original): The memory system according to claim 4, wherein said short-circuit device is an FET switch, which is provided in association with said memory modules, respectively, for short-circuiting or opening bus connection which is disconnected by removing said memory module, and

in replacing an arbitrary memory module, said control device generates a control signal for turning ON the FET switch provided in association with said memory module to be replaced and turning OFF the FET switches provided in association with the other memory modules.

11. (Original): The memory system according to claim 5, wherein said short-circuit device is an FET switch, which is provided in association with said memory modules, respectively, for short-circuiting or opening bus connection which is disconnected by removing said memory module, and

in replacing an arbitrary memory module, said control device generates a control signal for turning ON the FET switch provided in association with said memory module to be replaced and turning OFF the FET switches provided in association with the other memory modules.

12. (Previously presented): The memory system according to claim 3, wherein said short-circuit device is a connector, which is provided in association with said memory modules, respectively, and is provided with shorting pins which short-circuits bus connection, which is disconnected by removing said memory module, at the time when said memory module is removed, and releases the short-circuit at the time when said memory module is inserted.

13. (Previously presented): The memory system according to claim 4, wherein said short-circuit device is a connector, which is provided in association with said memory modules, respectively, and is provided with shorting pins which short-circuits bus connection, which is disconnected by removing said memory module, at the time when said memory module is removed, and releases the short-circuit at the time when said memory module is inserted.

14. (Previously presented): The memory system according to claim 5, wherein said short-circuit device is a connector, which is provided in association with said memory modules, respectively, and is provided with shorting pins which short-circuits bus connection, which is disconnected by removing said memory module, at the time when said memory module is removed, and releases the short-circuit at the time when said memory module is inserted.

15. (Previously presented): The memory system according to claim 2, wherein said storage is a memory module for mirroring which is provided with a memory area for holding data and a buffer section for sending and receiving data.

16. (Previously presented): The memory system according to claim 5, wherein said storage is a memory module for mirroring which is provided with a memory area for holding data and a buffer section for sending and receiving data.

17. (Original): The memory system according to claim 2, wherein said storage is a memory for graphics.

18. (Original): The memory system according to claim 5, wherein said storage is a memory for graphics.

19. (Original): The memory system according to claim 2, wherein said storage is free memory areas of the other memory modules excluding said memory module to be replaced.

20. (Original): The memory system according to claim 5, wherein said storage is free memory areas of the other memory modules excluding said memory module to be replaced.

21-38. (Canceled).

39. (New): A memory module comprising:

a memory area;

a buffer circuit performing data read and write operations on said memory area; and

first and second ports electrically connected to said buffer circuit,

said buffer circuit operating in a first mode to allow data to be input to said memory module to receive at one of said first and second ports and data to be output from said memory module to send at the other of said first and second ports, said buffer circuit further operating in a second mode to allow data to be input to said memory module to receive at either one of said

first and second ports and data to be output from said memory module to send at either one of said first and second ports.

40. (New): The memory module according to claim 39, further comprising a control port electrically connected to said buffer circuit, said buffer circuit operating and said first mode when said control port is supplied with first information and in said second mode when said control port is supplied with second information.

41. (New): A memory system comprising:
a plurality of memory modules each provided with memory areas storing data;
a control device performing data read and write operations on each of said memory modules; and
a bus interconnecting said memory modules in series to one another,
said control device having a first terminal electrically connected to one end of said bus and a second terminal electrically connected to the other end of said bus, said control device operating in a first mode to perform the data read and write operations on each of the memory modules by transferring data onto said bus through one of said first and second terminals and receiving data from said bus through the other of said first and second terminals, said control device further operating in a second mode to perform the data read and write operations on each of the memory modules by transferring and receiving data onto and from said bus through either one of said first and second terminals.

42. (New): The memory system according to claim 41, further comprising a CPU which is electrically connected to said control device, and controls said control device for access operation to said memory modules.

43. (New): The memory system according to claim 41, wherein said control device operates in said first mode when all of the memory modules are in service and in said second mode when at least one of the memory modules is out of service.